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Breakfast, *Giardia* and School Success of Girls in Ardebil Province, Iran

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ABSTRACT

Eating breakfast is important for the growth and nutritional well-being of children. The aims of the study were to compare nutrient intake, *Giardia* infection, mean score and anthropometric factors, in 2 groups, children who ate breakfast and children who did not.

This cross-sectional study was conducted with 20 randomly selected primary schools from 2 regions of Ardebil Province, Iran, in 2005. Anthropometric factors were measured, *ie* height, weight, and mid-arm muscle circumference (MAC) of 401 males. Three-day food intake was estimated for energy and other nutrients by 24-hour-recall method, and the children were asked whether they ate breakfast, or not. A stool specimen from each girl was prepared in saline and examined by light microscopy and direct smear using the zinc sulfate flotation method. The data were analyzed using independent samples-T test and Chi-square, and Iranian food processor.

Of the girls, 20.8% reported having skipped breakfast. Among the girls who ate breakfast, the *Giardia*-infected skipped breakfast more often than the non-infected (15.4% *vs* 12.2%), but the difference was insignificant. On average, the taller girls skipped breakfast significantly more often ($p < 0.05$), but height was not a significant factor among the boys. Weight, BMI (body mass index) and MAC among the children skipping breakfast were significantly higher than among those who ate breakfast ($p < 0.05$). The average mean scores were not significantly different. There was no association between eating breakfast and *Giardia* infection. The caloric and nutrient intakes of the children who ate or skipped breakfast were not significantly different.

In the present study, skipping breakfast was more prevalent among primary-school girls, which could affect anthropometric factors. However, it did not correlate with *Giardia* infection, school success, or caloric intake.

Keywords: *Giardia*, children, school, breakfast, anthropometric factors, nutrients

Introduction

Breakfast can be defined simply as the first meal of the day. What this bald definition fails to account for, however, is the importance of eating breakfast, particularly for growing children, who tend to skip breakfast more frequently than any other meal [1]. This dietary omission has been associated with poor school performance [2] and lower daily nutrient intake, which could lead to dietary inadequacies [3] for these children. Furthermore, poor eating habits established

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in childhood often continue into adulthood [4]. A limited number of studies have investigated secular trends of breakfast consumption or the influence of breakfast consumption on the total daily nutrient intake of children and young adults [5,6]. Studies have shown that breakfast provides important nutrients, and that individuals who skip breakfast do not compensate for potential nutrient and energy losses at other meals [7]. Deficiencies in vitamins A and B-6, iron, calcium, magnesium, copper, and zinc pose special problems for children [8]. Moreover, many studies have shown significant relationships between skipping breakfast and high body mass index (BMI) in adolescents [9-12]. For children, breakfast consumption has been associated with learning and better school performance [13]. Despite breakfast's positive attributes, many children go to school without breakfast [14]. A strong association between *Giardia* infection and under-nutrition, wasting, and stunting was noted in children [15].

The aims of the study were to compare nutrient intake, *Giardia* infection, mean score and anthropometric factors, in 2 groups, children who ate breakfast and children who did not.

Materials and methods

Study design and population

In this descriptive cross-sectional study, 394 females from 20 primary schools in 2 regions of Ardebil Province, Iran, were selected by multi-stage sampling. Their ages, anthropometric factors (height, weight, and mid-arm muscle circumference (MAC)), dietary methods, and school success, were examined. They all underwent stool examinations. A questionnaire was used to assess their histories of skipping or eating breakfast, and mean scores were calculated.

Anthropometric measurements

Height (to the nearest 0.5 cm) and weight (to the nearest 0.1 kg) were measured by the first author and trained research assistants using a Soehnle portable digital scale and portable digital stadiometer, respectively, according to the standard techniques. The students were measured without shoes and dressed in light summer school uniform. BMI was calculated from height and weight.

Dietary methods

Food intake was estimated for energy and other nutrients by 24-hour recall method for 3 days in a week, and subjects were also asked to record their breakfast consumption. Calorie and nutrient intake data were analyzed by Iranian food processor.

School success

Educational progression was assessed from the average test score for basic primary school class for the schoolchildren. The school success score was rated out of maximum possible score of 20.

Stool examination

Participants were aged 7-12 years. Each student was given a clean glass container to collect a stool sample. From each stool specimen, a direct saline preparation was prepared and examined by light microscopy. Samples that did not reveal any intestinal parasite on direct smear were examined further by zinc sulfate flotation method.

Statistical analysis

The results are expressed as mean ± SD. The data were analyzed by independent samples-t test and Chi square. The level of significance was set at $p < 0.05$.

Results

Of the total number of participants, 20.8% reported they had skipped breakfast. The girls who skipped breakfast tended to be significantly taller than those who did not ($p < 0.05$). Weight, BMI and MAC values for the group who omitted eating breakfast were significantly greater than those who ate breakfast ($p < 0.05$) (Table 1). The average mean score for the group who ate breakfast was higher (but not statistically significantly higher) than the group who skipped breakfast (19 ± 1.4 *vs* 18.8 ± 1.4). 14.5% of the girls had *Giardia* infections. The group of girls who ate breakfast had a higher rate of *Giardia* infection than the group who did not (15.4% *vs* 12.2%), but no significant relationship was found. Caloric and nutrient intakes (except for vitamin B2, and the calcium intakes of the 7-10 year-old boys) were not significantly different between the two groups (those eating and those

skipping breakfast) (Table 2). There was no significant relationship between *Giardia* infection and average mean score.

Discussion

Overall, 20.8% of participants reported having skipped breakfast. Nicklas *et al* [7] and Shaw [16] reported that 19% of American and 12% of Australian adolescents skipped breakfast, respectively. Haapalahti *et al* [17] showed skipping meals was uncommon among Finnish children aged 10-11 years. Skipping breakfast was associated with higher BMI [18]. In the present study, weight, BMI, and MAC in the group of children who skipped breakfast were

Table 1 Association between eating breakfast and anthropometric factors among the schoolchildren.

Variable	Age (year)	Girls			
		Eating breakfast ($\bar{x} \pm SD$)	N	Not eating breakfast ($\bar{x} \pm SD$)	N
Height (cm)	7	120.6 ± 5.5	68	116.3 ± 6.2	5
	8	124.1 ± 5.8	59	125.7 ± 6.1	9
	9	130.8 ± 7.4	55	132.9 ± 4.8	18
	10	134.3 ± 7.7	59	136.7 ± 9.1	25
	11	140.1 ± 6.9	54	136.8 ± 6.6	18
	12	144.1 ± 6.9	17	139.7 ± 11.3	7
	Total	130.3 ± 10.1	312	133. 7 ± 9.4*	82
Weight (kg)	7	22.5 ± 3.5	68	22.2 ± 2.2	5
	8	23.9 ± 3.5	59	29.4 ± 5.2*	9
	9	27.3 ± 4.9	55	32.6 ± 8.7*	18
	10	30.6 ± 6.7	59	33.2 ± 9.5	25
	11	33.6 ± 6.3	54	32.1 ± 5.8	18
	12	38.2 ± 7.2	17	38.6 ± 9.9	7
	Total	27.9 ± 7	312	32.2 ± 8.4*	82
BMI (kg/m^2)	7	15.4 ± 1.6	68	16.4 ± 1.6	5
	8	15.5 ± 1.5	59	17.1 ± 2*	9
	9	15.8 ± 1.6	55	17.6 ± 3.8*	18
	10	16.8 ± 2.8	59	17.5 ± 2.9	25
	11	17.1 ± 2.5	54	17.1 ± 1.8	18
	12	18.3 ± 2.6	17	19.6 ± 3.6	7
	Total	16.2 ± 2.2	312	17.5 ± 2.9*	82
MAC (cm)	7	17.5 ± 1.6	68	17.7 ± 1.9	5
	8	17.8 ± 1.4	59	20 ± 1.5*	9
	9	18.6 ± 1.7	55	20.7 ± 3.7*	18
	10	19.3 ± 2.3	59	20.2 ± 2.9	25
	11	19.9 ± 2.4	54	20.4 ± 2.7	18
	12	21.1 ± 2.1	17	21.6 ± 4.3	7
	Total	18.7 ± 2.2	312	20.3 ± 3*	82

Values are mean ± SD; * $p < 0.05$

Table 2 Association between eating breakfast with caloric and other nutrient intake, among the girls.

Variable	Girls					
	7-10 years			11-12 years		
	Breakfast eating ($\bar{x}$ ± SD) N = 252	Omission breakfast ($\bar{x}$ ± SD) N = 45	P value	Omission eating ($\bar{x}$ ± SD) N = 83	Breakfast breakfast ($\bar{x}$ ± SD) N = 13	P value
Calorie (cal)	1,723.6 ± 474.1	1,606.9 ± 471.2	0.09	1,692.3 ± 628.9	1,827.9 ± 412.5	0.22
Protein (g)	61.8 ± 27.6	60.6 ± 25.7	0.76	57.7 ± 33.7	68.3 ± 23.9	0.09
CHO (g)	246.4 ± 78.8	230.3 ± 65.3	0.15	245.9 ± 95.7	266.3 ± 70.6	0.26
Fiber (g)	11.1 ± 7.9	9.6 ± 4.7	0.16	10.6 ± 7.1	11.2 ± 5.7	0.65
Total fat (g)	56.7 ± 22.5	53.2 ± 20.5	0.27	56.5 ± 31.8	55.5 ± 22.2	0.86
Vitamin B1 (mg)	1.2 ± 0.4	1.2 ± 0.3	0.92	1.2 ± 0.5	1.3 ± 0.3	0.09
Vitamin B2 (mg)	1.1 ± 0.5	0.9 ± 0.7	0.83	0.9 ± 0.4	1.1 ± 0.5	0.11
Vitamin B3 (mg)	17.7 ± 9.7	18.3 ± 10.5	0.65	17.2 ± 12.4	19.5 ± 8.8	0.30
Vitamin B6 (mg)	0.9 ± 0.5	0.9 ± 0.4	0.96	0.9 ± 0.6	1.1 ± 0.6	0.38
Folacin (μg)	92.3 ± 65.3	93.9 ± 38.8	0.86	85.1 ± 74.5	93.4 ± 65.9	0.59
Vitamin B5 (mg)	2.8 ± 1.5	2.6 ± 1.4	0.76	2.3 ± 1.5	2.9 ± 1.7	0.14
Vitamin C (mg)	48.6 ± 37.2	52.2 ± 66.6	0.58	41.6 ± 27.7	44.2 ± 33.4	0.73
Vitamin E (mg)	2.9 ± 2.1	2.8 ± 1.8	0.61	4.2 ± 2.1	2.9 ± 2.8	0.14
Ca (mg)	508.1 ± 301.5	443.5 ± 255.9	0.13	409.8 ± 217.9	488.9 ± 259.1	0.17
Cu (mg)	0.7 ± 0.4	0.6 ± 0.3	0.18	0.7 ± 0.5	0.7 ± 0.4	0.87
Fe (mg)	15.8 ± 7.3	16.4 ± 10.1	0.63	15.1 ± 8.2	17.3 ± 5.5	0.12
Mg (mg)	115.6 ± 60.9	116.6 ± 85	0.91	101.8 ± 63.1	119.2 ± 56.3	0.20
P (mg)	656.3 ± 322.6	639.5 ± 262.5	0.66	600.8 ± 376.4	669.7 ± 330.2	0.39
K (mg)	1,590.2 ± 863.7	1,469.3 ± 787.9	0.33	1,521.3 ± 1095.8	1,568.1 ± 794.2	0.82
Se (μg)	36.6 ± 21.2	34.8 ± 24.6	0.58	44.3 ± 35.7	42.3 ± 24.7	0.75
Na (mg)	2,049.3 ± 1,149.2	2,079.8 ± 1,137.2	0.85	1,906.9 ± 1,414	2,059.8 ± 1,122.8	0.58
ZN (mg)	4.6 ± 2.4	4.5 ± 2.2	0.78	4.8 ± 3.2	5.2 ± 2.6	0.58

CHO = carbohydrate, Ca = calcium, Cu = copper, Fe = iron, Mg = magnesium, P = phosphorus, K = potassium, S = selenium, Na = sodium, Zn = zinc

significantly higher than the group who ate breakfast. Children who ate breakfast had a lower risk of being overweight. These findings confirm and clarify the impact of skipping breakfast on BMI—the high BMI among the group of children who skipped breakfast was indeed related to skipping breakfast. Conversely, eating breakfast may result in children having normal BMI. Other studies, including Stockman *et al* [19] and Berkey *et al* [11], have yielded similar results, showing that irregular breakfast consumption was significantly associated with being overweight. The reduced likelihood of breakfast consumption is of particular concern in light of growing evidence of a link between breakfast consumption and academic performance, school attendance, and other psychosocial factors [20]. When children completed a visual-perception or spatial-memory task, they generally performed better after consuming breakfast. The benefit is most likely related to the blood glucose response following a meal. Modest increases in circulating glucose enhance learning and memory [21], perhaps through the synthesis of acetylcholine [22]. However, only

limited data suggest that the type of breakfast also influences cognitive functioning [23,24]. Studies have shown that breakfast provides important nutrients and that individuals who skip breakfast do not compensate for potential nutrient and energy losses at other meals [25,26]. Our study showed the difference in average mean scores between the breakfast eaters and non-eaters was insignificant. In children, breakfast consumption has been linked to nutritional adequacy. In spite of this study, Chitra *et al* [27] showed the average total energy intake was significantly lower among children who did not eat breakfast. Children who consumed breakfast had higher daily intakes of energy and protein than children who skipped breakfast. Compared with the breakfasting group, a significantly higher percentage of the non-breakfasting group failed to meet two-thirds of the National Academy of Science's recommended dietary allowances for vitamins A, B-6, and D, calcium, magnesium, riboflavin, folacin, and nutrients such as zinc, phosphorus, and iron [3]. Our study showed the energy and protein intakes, and intake of some nutrients among the breakfasting schoolchildren was slightly higher than the group who skipped breakfast.

Conclusion

This study showed that a high proportion of schoolchildren in Ardebil Province, Iran, skipped breakfast on school days. The omission of breakfast correlated with overweight, but not with *Giardia* infection, school success, or caloric/nutrient intake.

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